# A Protocol for Quantifying and Reporting the Performance of Anaerobic Digestion Systems for Livestock Producers

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# Support

- The Association of State Energy Research and Technology Transfer Institutions (ASERTTI)
- The U.S. Environmental Agency's AgSTAR Program
- The U.S. Department of Agriculture Rural Business Service

# Purpose

To provide:

1. System developers with a standard approach to quantify performance and support claims that will receive general acceptance as credible, and
2. Third parties with the same approach for independent performance evaluations.

# The Development Process

- Preparation of first draft for discussion,
- A workshop held in Chicago in late January to review and provide suggestions for revisions,
- Preparation of a final draft, and
- Solicitation of additional comments and suggestions.

# Structure of the Protocol

- Prerequisites for performance evaluations
- Specification of required background information
- Requirements for characterizing performance with respect to:
  - Waste stabilization
  - Biogas production and utilization
  - Greenhouse gas emissions reductions
- Standards for economic analysis

# Prerequisites for Performance Evaluations

- Full-scale systems located on commercial livestock operations
- A minimum of 12-months in duration
- Steady-state conditions after completion of start-up (minimum requirements)
  - —Plug-flow & mixed digesters: 5 HRTs
  - —Covered lagoons: one year
  - —Attached film digesters: 3 months of warm weather operation

# Required Background Information

- Name, location, and type of operation
- Type, age and number of animals
- Type of manure handling system
- Type of digester and design details
- Type of biogas utilization system with design details
- Source(s) of revenue from biogas production

# Waste Stabilization

- Parameters:
  - Minimum:  TS, TVS, COD, and pH
  - Optional:  TVA, TKN, ON, $NH_4$-N, TP, indicator organisms, and pathogens
- Sample collection:  representative composites of 24-hour flows
- Frequency of sample collection:  monthly or semi-monthly?
- Sample preservation and analytical methods

# Biogas Production & Utilization

- Measuring production:  total and utilized
- Biogas composition:  $CH_4$, $CO_2$, $H_2S$, and $NH_3$
- Utilization:
  - Generating electricity:  kWh generated, thermal conversion efficiency, and waste heat recovered and utilized or potentially available
  - Boiler fuel:  Conventional fuel Btu replaced
- Reporting standards:  The per animal-day problem with co-digestion

# Greenhouse Gas Emissions

- Methane—Inventory of U.S. Greenhouse Gas Emissions and Sinks:  1990-2003 (USEPA, 2005) methodology

- Carbon Dioxide—2,249 lb $CO_2$ per MWh (Spath *et al*., 1999)

# Economic Analysis—Costs

- General approach: an independent enterprise
- Boundary conditions: exclusions and inclusions
- Annual capital cost: cannot exclude recovery with interest of an owner's investment
- Annual operating and maintenance costs: a better basis for estimation is needed

# Economic Analysis—Revenue

- Valuing on-farm energy use:  rate structure differences and demand charge impacts need to be included
- Revenue from by-products:  what is valid and what is not

# Next Steps

- Selecting a gatekeeper
- Establishing a review process
- Establishing and maintaining a distribution process (probably a website)
- Considering a certification program

# Thank-you

Questions?